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UNMANNED AERIAL VEHICLES

DOD's Acquisition Efforts

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Mr. Chairmen and Members of the Subcommittees:

I am pleased to be here today to briefly discuss the Unmanned Aerial Vehicle (UAV) acquisition efforts that the Department of Defense (DOD) has undertaken over the past 15 years. My comments are based on our reviews of a number of UAV programs, including Aquila, Pioneer, the Medium Range UAV, Hunter, Outrider, and Global Hawk.[1] After a short summary, I would like to present you with a chronological discussion of the descriptions and outcomes of some of these programs, and then provide you with some key observations about DOD's UAV acquisition efforts.

Summary

According to DOD, its objective in acquiring UAVs is to provide unmanned systems that will complement its mix of manned and national reconnaissance assets. However, its UAV acquisition efforts to date have been disappointing. Since Aquila began in 1979, of eight UAV programs, three have been terminated (Aquila, Hunter, Medium Range), three remain in development (Outrider, Global Hawk, DarkStar), and one is now transitioning to low rate production (Predator). Only one of the eight, Pioneer, has been fielded as an operational system. We estimate DOD has spent more than $2 billion for development and/or procurement on these eight UAV programs over the past 18 years.

Outcomes of DOD's UAV Acquisition Efforts

DOD's first major post-Vietnam UAV acquisition efforts, Aquila, Pioneer, and the Medium Range UAV, were managed by the services. The Congress has strongly supported DOD's acquisition of UAVs and has sought to encourage cooperation among the military services. In 1987, the Congress consolidated funding for UAVs in a single Defense Agencies account instead of separate service accounts. This action led to the formation of DOD's UAV Joint Projects Office in 1988 to manage and control UAV programs as joint efforts and prevent unnecessary duplication by the services.

The Defense Airborne Reconnaissance Office within the Office of the Secretary of Defense oversees the Joint Projects Office. Joint programs undertaken that we have reviewed include Hunter, Outrider, Global Hawk, Predator and DarkStar.

Aquila

The Army's first major UAV acquisition effort was the Aquila program. This program started in 1979 and was originally estimated to cost $123 million

[1]A chronological list of our prior UAV reports appears at the end of this testimony.

for a 43-month development effort, followed by planned expenditures of $440 million for procurement of 780 air vehicles and associated equipment. By the time the Army abandoned the program in 1987 due to cost, schedule, and technical difficulties, Aquila had cost over $1 billion, and future procurement costs were expected to have been an additional $1.1 billion for 376 aircraft.

The original mission for Aquila was to have been relatively straightforward: it was to be a small, propeller-driven aircraft (portable by four soldiers) that could provide ground commanders with real-time battlefield information about enemy forces located beyond the line of sight of ground observers. As development was nearing completion, it became evident that the requirement for the small aircraft size conflicted with the many avionics and payload-related items the Army wanted to put inside the UAV. Aquila was expected to fly by autopilot, carry sensors to locate and identify enemy point targets in day or night, use a laser to designate the targets for the Copperhead artillery projectile, provide conventional artillery adjustment, and survive against Soviet air defenses. Achieving the latter expectation required development of a jam-resistant, secure communications link, but using the secure link degraded the video quality, which interfered with the ability to do targeting. During operational testing in 1987, Aquila was only able to successfully meet mission requirements on 7 of 105 flights.

Pioneer

After having been impressed by stories of Israeli successes with UAVs in the early 1980s, the Navy initiated an expedited procurement of UAV systems. These systems were to serve as spotters for naval gunfire support from its battleships, as well as provide a UAV capability for the Marine Corps. The resulting Pioneer, produced by a joint venture of an American and Israeli firms, skipped the traditional U.S. development phase of the acquisition process, and nine systems, each with eight air vehicles, were procured beginning in 1986 at an estimated cost of $87.7 million. Similar to Aquila, Pioneer was a small, propeller-driven aircraft.

The Pioneer began to encounter unanticipated problems almost immediately. Recovery aboard ship and electromagnetic interference from other ship systems were serious problems that led to a significant number of crashes. The Pioneer system also suffered from numerous other shortcomings. Ultimately, the Navy undertook a $50 million research and development effort to bring the nine Pioneer systems up to a level it described as a "minimum essential capability." Although Pioneer has never

met objective requirements, the Navy and Marine Corps used the Pioneer in Operation Desert Storm, and operations in Somalia and, most recently, Bosnia. DOD plans to phase out Pioneer when the Outrider, which is now in development becomes available.

Medium Range UAV

The Medium Range UAV began as a joint effort of the Navy and Air Force. The Medium Range UAV was to augment the services' manned penetrating reconnaissance aircraft, such as the Air Force's RF-4C. Like these manned aircraft, the Medium Range UAV was to be powered by a jet engine and penetrate enemy airspace at high subsonic speed, and not slowly loiter for long periods over hostile territory like Aquila or Pioneer. The operational concept called for the Medium Range UAV to precede strike aircraft deep into hostile airspace (350 nautical miles) and relay back near-real-time video that could be used by aircrews and mission planners to identify the highest priority targets and help plan the safest and most effective ways to strike them. The UAV would then return after the air strikes were completed to conduct battle damage assessment.

The Medium Range UAV began as a multiservice, cooperative venture. The Navy was to design and build the air vehicle. Air vehicle development costs were estimated to be $387 million in 1993. The Air Force would design and build the sensor payload with cameras, videotape recorder, and communications data link to send back the imagery from the UAV. Payload development was originally estimated to cost $164 million. Unfortunately, the Air Force ran into major difficulties with the payload. Development costs grew to an estimated $346 million, the payload program fell behind schedule, and developmental tests on a surrogate manned aircraft were not successful.

The Navy encountered design problems as well, and one test aircraft crashed. Perhaps most significantly for the Medium Range UAV program, the prototype payload ended up being too big to fit in the space the Navy had allotted inside the aircraft. In June 1993, the Air Force terminated the payload contract due to technical difficulties. The Medium Range UAV was terminated in October 1993 by DOD for affordability reasons.

Hunter

The Joint Project Office's first UAV acquisition effort was the Short Range UAV, subsequently named the Hunter. The program was started in 1988. It was originally estimated to cost about $1.2 billion for development and procurement of 50 systems with 400 Hunter air vehicles and other

associated equipment. However, by the end of the program in 1995, the cost was expected to be $2.1 billion for development and procurement of 52 systems.

The mission of the Hunter was to be day and night reconnaissance, intelligence, surveillance, and target acquisition for Corps Commanders. It was to be deployed to Army divisions and corps, as well as naval task forces, and operate at a range of 200 kilometers. Because of line-of-sight limits, the system's range and ability to see over terrain were dependent on the use of a second Hunter air vehicle operating at a closer range to relay imagery from the first air vehicle to the task force or ground commander.

During Limited User Testing in 1992, Hunter's demonstrated problems included the inability to reliably transmit video imagery during relay operations, meet Army time standards for artillery adjustments, and meet standards for reliability. The Hunter system, with all its associated parts and support vehicles, was also far too large to fit in the number of airlift aircraft specified for moving one system. Nevertheless, DOD awarded a $171 million low-rate initial production (LRIP) contract for seven Hunter systems in early 1993. Subsequent logistics demonstrations in 1993 revealed that the system could not be supported in the field.

The Hunter contractor began delivering the seven LRIP systems in May 1994. Government acceptance testing of these systems revealed new deficiencies with the system's software, data link and engines. Several crashes occurring in short order led to the system being grounded for months. DOD terminated the program in January 1996 by allowing the contract to expire.

Outrider

In the wake of the Hunter termination, DOD awarded a $57-million contract in 1996 for six Outrider Tactical UAV systems. DOD will evaluate the military utility of the Outrider through multiservice demonstrations. The demonstrations will determine if Outrider can fulfill the role for which it was originally designed—reconnaissance and surveillance within 50 kilometers—as well as cover the 200-kilometer range that was the Hunter objective. Outrider systems are intended to be fielded with Army brigades and battalions, Navy task forces, and Marine Corps regiments and battalions. Between now and 2003, if the demonstrations are successful, DOD will spend $268.5 million on Outrider UAV and associated system development and $583.2 million for procurement of 60 Outrider systems with 240 aircraft.

Predator

Predator UAV development was completed during a 30-month advanced concept technology demonstration (ACTD) that ended in June 1996.[2] The demonstration process allowed DOD to procure Predator UAVs for testing while avoiding much of the paperwork and oversight of the traditional acquisition process. Predator is now beginning LRIP as a traditional acquisition program. Development and procurement costs are estimated at $579 million for 13 Predator systems with 80 air vehicles.

Predator's mission will be to support the Theater Commander and Joint Force Commander with long-range (500 nautical miles), long time-over-target (more than 20 hours), near-real-time imagery to satisfy reconnaissance, surveillance, and target acquisition requirements. Going beyond the capabilities of the smaller UAVs being developed for ground and task force commanders (such as Outrider), the much larger Predator will be equipped with adverse weather payloads and satellite relay data links. Each Predator system will consist of four air vehicles, related ground support equipment, and a large complement of personnel. During the demonstration phase, Predator UAVs were deployed to Albania to support Bosnia operations in 1995 and two were lost, one to hostile fire and one reportedly to engine failure. After improvements, Predator was deployed to Hungary in 1996 to support NATO operations in Bosnia. Experience with Predator deployments showed that the system can be adversely affected by unfavorable weather conditions. The Air Force assumed operational control of the remaining Predator demonstration assets in October 1996.

Global Hawk

The Global Hawk UAV is in development as an advanced concept technology demonstration project. Unlike the small propeller-driven aircraft designed for "seeing over the next hill", Global Hawk is a high-altitude endurance UAV. It is intended to reach altitudes of up to 65,000 feet, have a radius of 3,000 nautical miles, remain over the target area for 24 hours, and have total endurance of greater than 40 hours. Global Hawk is expected to fly surveillance missions in which long range, extended endurance and long periods of time over the target area are paramount.

The Global Hawk airframe is a conventional aircraft design, offering no special protection from enemy radar systems. As a result, DOD plans to procure Global Hawk UAVs along with another high-altitude endurance UAV, the DarkStar, that will be a "stealth" design. Global Hawks will be used in

[2]As part of its acquisition reform efforts, DOD has authorized a number of ACTDs to try to streamline the acquisition process.

low-to-medium risk environments, while DarkStars will be used in high-risk areas. The planned first flight of Global Hawk has been delayed from February to late fall 1997.

DarkStar

As with Global Hawk, the DarkStar high-altitude endurance UAV is being developed as part of an advanced concept technology demonstration program. Unlike Global Hawk, DarkStar is to be optimized to penetrate and operate in the presence of high-threat air defense systems in which ensured coverage and survivability are more important than total endurance. DarkStar is designed to have low-observable characteristics to minimize the vehicle's radar detectability and enhance survivability.

DarkStar is projected to fly at a high altitude (greater than 45,000 feet), have a radius greater than 500 nautical miles and be able to remain over the target area for 8 hours. The DarkStar program will utilize the same manned common ground segment for launch and recovery, control, and communications as Global Hawk. The planned first flight of DarkStar occurred in March 1996; however, a second flight in April 1996 crashed. The next flight is scheduled for September 1997.

Mr. Chairmen, with this overview of past and ongoing UAV efforts as a backdrop, let me make several observations that decision-makers may want to keep in mind when addressing proposals for further UAV acquisition.

Observations About UAV Acquisition

1. The more you ask a UAV to do, the harder it becomes to build. UAV system acquisitions need to be protected from what is known as "requirements creep." Just because another capability could conceivably be added to a UAV does not mean it should be added as a requirement. Any proposed new requirement should be judged by its overall effect on the acquisition program in terms of cost, schedule, and performance. DOD's experience with the Aquila UAV acquisition effort in particular showed that a system that was intended to provide ground commanders with a simple reconnaissance capability, that is, "to see over the next hill," was at least partly undermined by additional requirements, such as capability for precision targeting.

2. UAV "availability" should not be construed as "capability." Several UAV acquisition efforts have reflected preconceived notions that, because the technologies being inserted into a UAV system are considered mature, any

resulting systems composed of those technologies will be mature. This notion is most visible when a UAV is proffered to DOD and the Congress as being a "nondevelopmental item," or being available "off-the-shelf." A number of our studies have shown that these UAVs cannot be assumed to meet DOD or service requirements. The reality is that, after having been subjected to the rigors of realistic operating environments and/or wartime operating tempos, UAVs procured as nondevelopmental items often have to be returned to the research and development cycle. Making them useful to the military users can involve great unanticipated expenses.

3. When you buy a UAV, remember you are buying more than an unmanned aircraft. The air vehicle is only the most visible portion of that system. Besides air vehicles, a UAV system includes numerous other items, such as computer processors and software, sensor payloads, data links, data dissemination equipment, ground control stations, launch and recovery equipment, and a logistics support network. Our reviews have shown that, before production begins, DOD needs to ensure that adequate testing has shown that the necessary parts have been proven to work successfully together, and that the entire system will be affordable to operate and maintain throughout its lifecycle.

Mr. Chairman, this concludes my prepared statement. I would be happy to respond to any questions you may have. Appendix I provides additional information on DOD's major UAV acquisition efforts.

Aquila

Program started in 1979; ended in 1988.

Cost estimates (dollars in millions)

	Original (1978)	Last (1987)
Development	$123	$868
Procurement	440	1,157
Total	**$563**	**$2,025**
Number of aircraft	780	376

Mission: To support brigade commanders fire support mission with laser target designation and artillery adjustment; to be survivable against Soviet air defenses; and be forward located.

Design requirements: television/laser designator payload; lightweight, manportable air vehicle; low detectability; secure, jam-resistant data link; An Aquila system consisted of 13 air vehicles and related ground support equipment.

During operational testing in 1986-87, Aquila successfully met its mission requirements on only 7 of 105 flights. Specific problems occurred in launch, targeting, survivability, reliability. Test criteria were not rigorous and contractors were found to have unduly influenced the scoring of test data.

Observations on reasons for problems: A lightweight man-portable air vehicle suitable for location with front-line troops was inadequate for satisfying the extensive performance requirements.

Congress withdrew support for the program and directed DOD to combine Aquila funding into an overall UAV line item.

Hunter

Program started in 1989; ended in 1996.

Cost estimates (dollars in millions)

	Development estimate	Last estimate
Development	$ 138.2	$ 189.2
Procurement	1093.4	1893.7
Military construction		15.8
Total	**$1231.6**	**$2098.7**
Number of systems	50 with 400 aircraft	52 with 416 aircraft

Mission: To provide corps and division level ground and maritime forces with near-real-time imagery intelligence within a 200 km direct radius of action, extensible to 300+ km using relay operations. Relay operations involve controlling one air vehicle, operating at long range, through a relay payload on another air vehicle operating at a closer range.

Design requirements: Television, infra-red, and relay payloads; A single Hunter system consists of 8 air vehicles with sensors and related ground support equipment.

During Limited User Testing in 1992, Hunter successfully completed only 4 of 11 relay flights. Test results revealed (1) the system's ability to transmit video imagery during relay operations was unacceptable for a fielded system, (2) the system may never meet Army time standards for artillery adjustments, and (3) the system was unreliable.

DOD awarded a $171 million low-rate production contract for 7 Hunter systems in early 1993. Logistics Demonstrations in 1993 revealed that the system was not yet sustainable and did not have a support structure in place. Government acceptance testing of the low-rate production systems revealed new deficiencies with the systems software, datalink and engines. Observations on reasons for problems: DOD did not allow enough time to perform (1) system integration necessary to integrate non-developmental components of the system or (2) analyses necessary to develop a logistic support system. DOD terminated the program in January 1996 by allowing the contract to expire.

Outrider

The Outrider Advanced Concept Technology Demonstration began in May 1996. DOD plans for the Outrider ACTD to last 2 years and then transition to traditional acquisition if successful.

Cost estimates (dollars in millions)	
Development	$268.5
Procurement	583.2
Total	**$851.7**
Number of systems/air vehicles	60 systems/240 air vehicles

Mission: To support tactical commanders with near-real time imagery intelligence at ranges beyond 200 km and on-station endurance greater than 4 hours.

Design requirements: Television and infra-red payloads, Outrider air vehicle not to cost more than $350,000 for the 33rd air vehicle and sensor and $300,000 for 100th air vehicle and sensor; A single Outrider system consists of four air vehicles with sensors and related ground equipment.

DOD plans to examine the military utility of the Outrider system in a series of operational demonstrations. If the operational demonstrations are successful, DOD plans to exercise a low-rate initial production contract option for up to 6 systems in third quarter fiscal year 1998.

Predator

Predator completed a 30 month Advanced Concept Technology Demonstration (ACTD) June 30,1996. Predator begins low-rate initial production and becomes a traditional acquisition program in fiscal 1997.

Cost estimates (dollars in millions)	
Development	$ 209.9+
Procurement	368.8
Total	**$578.7+**
Number of systems/air vehicles	13 systems/80 vehicles[a]

[a]Includes 3 vehicles lost—1 to hostile fire; 1 reportedly to engine failure; 1 production vehicle in flight testing.

Mission: To support the in-theater Commander-in-Chief, National Command Authority, and Joint Force Commander with long-range (500 nautical miles), long time over target (more than 20 hours), near-real-time imagery intelligence necessary to satisfy reconnaissance, surveillance and target acquisition requirements

Design requirements: Television, infra-red, and adverse weather payloads; line-of-sight and satellite relay data links; Each Predator System consists of four air vehicles and related ground support equipment including one Trojan Spirit II Dissemination System.

As part of the ACTD, Predator was deployed to Albania to support U.S. and NATO Bosnia operations from July through November 1995. After improvements, including adding an adverse weather sensor, Predator was deployed to Hungary from March 1, 1996, to February 1997, to again support NATO operations in Bosnia.

The Air Force assumed operational control of Predator assets on September 2, 1996.

Global Hawk

Cost estimate (dollars in millions)	
Development (air vehicles)	$370.7
Development (Common Ground Segment-shared with DarkStar)	272.6
Total RDT&E	**$643.3**
Number of systems/air vehicles	3 Ground Segments/8 UAVs

Mission: Global Hawk is intended to complement manned and national reconnaissance assets by providing continuous unmanned all-weather, wide-area high resolution imagery coverage in support of military operations. It is to operate in low to moderate risk threat environment after the suppression of enemy air defense and to optimized to support those surveillance missions in which long-range, extended endurance and long dwell over the target area are paramount.

System description/characteristics: The Global Hawk is an Advanced Concept Technology Demonstration program. It is projected to be a fully integrated system consisting of the air vehicle, electro-optical/infrared and synthetic aperture radar sensors, communications, and the capability to disseminate collected imagery in near-real-time to tactical warfighters at various levels of command. It is to be interoperable with existing reconnaissance architectures for data collection processing, exploitation, and dissemination. Global Hawk is expected to operate at a moderate speed of 345 knots, a high altitude of up to 65,000 feet, have a radius of 3,000 nautical miles and then be able to remain on station for 24 hours, and endurance of greater than 40 hours. The system also includes a manned Common Ground Segment to be located at a forward operating base that will provide launch and recovery, mission control, ground communications, and is also to be common to and interoperable with the stealthy DarkStar high altitude endurance UAV.

The planned first flight of Global Hawk has been delayed from February to late fall 1997.

DarkStar

Cost estimates (dollars in millions)	
Development (air vehicles)	$326.9
Development (Common Ground Segment)	(Shown with Global Hawk)
Total RDT&E	**326.9**
Number of systems/air vehicles	6 UAVs[a]

[a]DarkStar will utilize Common Ground Segments with Global Hawk.

Mission: DarkStar is intended to complement manned and national reconnaissance assets by providing unmanned long dwell, all-weather, wide-area high resolution imagery coverage in support of military operations in heavily defended areas. Unlike Global Hawk, it is to be optimized to penetrate and operate in the presence of high threat air defense systems where assured coverage and survivability are more important than total endurance.

System description/characteristics: The DarkStar is an Advanced Concept Technology Demonstration program. It is projected to be a fully integrated system consisting of the air vehicle, electro-optical and synthetic aperture radar sensors, as well as the associated command, control, and sensor data links to disseminate collected imagery in near-real-time to tactical warfighters at various levels of command. It is to be interoperable with existing reconnaissance architectures for data collection processing, exploitation, and dissemination. DarkStar is designed to have low-observable characteristics to minimize the vehicles radar detectability and enhance survivability. It is expected to operate at a speed of greater than 250 knots, a high altitude greater than 45,000 feet, have a radius greater than 500 nautical miles and then be able to remain on station for 8 hours, and mission endurance greater than 8 hours. The DarkStar program also includes the manned Common Ground Segment that will be located at a forward operating base to provide launch and recovery, mission control, ground communications, and is also to be common to and interoperable with the conventional Global Hawk high altitude endurance UAV.

The planned first flight of DarkStar occurred in March 1996; however, a second flight in April 1996 crashed due to incorrect aerodynamic modeling of the vehicles flight control laws. The flight control laws have been redesigned and the next flight is scheduled for October 1997.

Related GAO Products

Unmanned Aerial Vehicles: Hunter System Is Not Appropriate for Navy Fleet Use (GAO/NSIAD-96-2, Dec. 1, 1995).

Unmanned Aerial Vehicles: Maneuver System Schedule Includes Unnecessary Risk (GAO/NSIAD-95-161, Sept. 15, 1995).

Unmanned Aerial Vehicles: No More Hunter Systems Should Be Bought Until Problems are Fixed (GAO/NSIAD-95-52, Mar. 1, 1995).

Unmanned Aerial Vehicles: Performance of Short-Range System in Question (GAO/NSIAD-94-65, Dec. 15, 1993).

Unmanned Aerial Vehicles: More Testing Needed Before Production of Short-Range System (GAO/NSIAD-92-311, Sept. 4, 1992).

Unmanned Aerial Vehicles: Medium-Range System Components Do Not Fit (GAO/NSIAD-91-2, Mar. 25, 1991).

Unmanned Aerial Vehicles: Realistic Testing Needed Before Production of Short-Range System (GAO/NSIAD-90-234, Sept. 28, 1990).

Unmanned Vehicles: Assessment of DOD's Unmanned Aerial Vehicle Master Plan (GAO/NSIAD-89-41BR, Dec. 9, 1988).

Aquila Remotely Piloted Vehicle: Its Potential Battlefield Contribution Still in Doubt (GAO/NSIAD-88-19, Oct. 26, 1987).

Aquila Remotely Piloted Vehicle: Recent Developments and Alternatives (GAO/NSIAD-86-41BR).

The Army's RPV Shows Good Potential, but Faces a Lengthy Development Program (GAO/C-MASAD-82-8, Feb. 26, 1982).

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